

# Avoiding Patient Harm From a Magnesium Bolus Dose

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**PROBLEM:** The Institute for Safe Medication Practices (ISMP) has published descriptions of events related to magnesium overdoses.<sup>1</sup> Most of the errors were a result of misprogrammed pumps, unfamiliarity with safe doses and signs of magnesium toxicity, inadequate monitoring, and mixups between magnesium and oxytocin. An example follows.

## Case Study

A 27-year-old pregnant woman was admitted to a labor-and-delivery unit with cramping, abdominal pain, vaginal bleeding, and leakage of amniotic fluid. Although she was only 27 weeks pregnant, an examination showed that she was in the early stages of labor with a breech baby. In an attempt to stop the preterm labor from progressing, the obstetrician prescribed intravenous (IV) magnesium sulfate, with a bolus dose of 6 g over 30 minutes, followed by a continuous infusion of 2 g/hour.

The patient's nurse obtained a 20-g/500-mL bag of magnesium sulfate from an automated dispensing cabinet. The nurse was unfamiliar with programming a bolus dose using the software in the smart infusion pump. The bolus dose feature allows the user to program the pump to deliver a bolus dose (6 g/30 minutes) and then automatically switches to deliver a continuous infusion (2 g/hour) after the bolus dose has been administered.

Not knowing how to use this feature, the nurse programmed the bolus to be delivered as a continuous infusion at 12 g/hour. The pump did not provide a "hard stop" to guard against an excessive dose of magnesium during continuous infusion. The nurse intended to return to the patient's room in 30 minutes to reprogram the pump to deliver 2 g/hour. However, she was distracted by other responsibilities and failed to return to the patient's room to adjust the

infusion rate as planned.

The patient became flushed and short of breath, and she called for a nurse. When the nurse arrived, the patient also complained of dizziness and was found to be hypotensive. She quickly became unresponsive, requiring brief cardiopulmonary resuscitation. Magnesium toxicity was suspected, and the infusion was stopped. The patient was given a rescue dose of IV calcium. Laboratory results confirmed a supratherapeutic magnesium blood level.

Fortunately, the patient responded to emergency treatment. The baby was delivered by cesarean section several days after the event because of unrelated preterm complications. Both the mother and child were eventually discharged with no permanent harm.

**SAFE PRACTICE RECOMMENDATIONS:** To avoid serious adverse effects from IV magnesium sulfate, bolus doses should not exceed 6 g over a 15-to 20-minute period, and continuous infusion rates should not exceed 3 g/hour. In this case, the infusion ran at 12 g/hour for more than 1 hour. The following measures should be instituted to avoid unnecessary harm from IV magnesium sulfate bolus doses.

1. The dose should never be infused from the maintenance solution unless **all** of these criteria are **consistently** met:
  - a. The bolus is delivered via the bolus dose feature with a smart infusion pump that allows programming of both the bolus dose and continuous infusion rate. When the bolus dose has been administered, there is an automatic switch to the continuous infusion rate.
  - b. Separate dose limits have been set for bolus doses of magnesium sulfate (e.g., 6 g/30 minutes) and maintenance doses (e.g., 3 g/hour).
  - c. These dose limit alerts remain operational at all times.
  - d. The alerts are configured as a

hard stop, which forces the user to reprogram the infusion if the dose exceeds safe limits.

- e. A qualified nurse remains at the bedside during infusion of the bolus dose to monitor the patient for signs of magnesium toxicity.

If these five conditions are not consistently met, the ISMP recommends administering the bolus dose from a separate container prepared by the pharmacy. A commercially available 4-g minibag can also be used if a 4-g bolus dose is prescribed.

If the five conditions are consistently met, all users of smart pumps must have received training to program the pump—including bolus doses—and they must be able to demonstrate ongoing competency. Bypassing the bolus dose functionality or employing a "generic" setting on a smart pump is unsafe.

2. For maintenance solutions, the ISMP recommends using only the 20-g/500-mL bags of magnesium sulfate, not the 40-g/1,000-mL bags. The 500-mL bag is easier to differentiate from liter bags of hydrating solutions and medications used during labor and delivery. The smaller volume also helps limit the amount of magnesium that a patient could receive if a rapid infusion occurs accidentally.
3. For added safety, some organizations only use the 4-g minibags for maintenance infusions, which call for frequent bag changes, but they limit the amount of drug that the patient can receive if an error occurs. Some facilities also require an independent double-check of pump settings before magnesium (bolus and maintenance) infusions are started.
4. During IV magnesium administration, the patient's vital signs, oxygen saturation, deep tendon reflexes, level of consciousness, and fetal heart rate characteristics with maternal uterine activity should be

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- frequently monitored. While giving a bolus dose, a nurse should remain at the bedside to monitor the patient and to watch for clinical manifestations of magnesium toxicity.
5. Generalized neuromuscular abnormalities, visual changes, facial flushing, nausea, somnolence, and weakness are often initial presenting symptoms, which can progress to hypotension (refractive to vasopressors or volume expanders); muscle paralysis; coma; hypoactive tendon reflexes; respiratory failure; paradoxical bradycardia; a prolonged PR, QRS, and QT interval; and complete heart block, cardiac arrest, or both.
  6. If symptoms of magnesium toxicity are present, the patient should be treated immediately and the possibility of an error should be investigated.
  7. Calcium gluconate should be stocked nearby with directions for use if respiratory depression occurs.
  8. Staffing patterns should allow time for proper monitoring, and protocols should include periodic monitoring of magnesium blood levels.
  9. When magnesium sulfate is discontinued, the bag and tubing should be removed immediately and discarded to avoid potential mixups with other IV fluids and medications.
  10. Staff members should not be misled by a solid safety record in their labor-and-delivery unit. Complacency with using IV magnesium sulfate could eventually lead to a tragedy. All hospitals and birthing centers that offer obstetrical services should not delay in implementing these error-reduction strategies.

## REFERENCE

1. Grissinger M. Preventing magnesium toxicity in obstetrics. *P&T* 2009;34(8):403. ■